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APPLICATION NO.	FILING DATE	FIRST NAMED INVENTOR	ATTORNEY DOCKET NO.	CONFIRMATION NO.
09/255,856	02/23/1999	TOMIO IWASAKI	501.39631X00	9089

7590 06/23/2004
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EXAMINER

SMOOT, STEPHEN W

ART UNIT	PAPER NUMBER
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2813

DATE MAILED: 06/23/2004

Please find below and/or attached an Office communication concerning this application or proceeding.

Office Action Summary

Application No.

09/255,856

Applicant(s)

IWASAKI ET AL.

Examiner

Stephen W. Smoot

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-- The MAILING DATE of this communication appears on the cover sheet with the correspondence address --

Period for Reply

A SHORTENED STATUTORY PERIOD FOR REPLY IS SET TO EXPIRE 3 MONTH(S) FROM THE MAILING DATE OF THIS COMMUNICATION.

- Extensions of time may be available under the provisions of 37 CFR 1.136(a). In no event, however, may a reply be timely filed after SIX (6) MONTHS from the mailing date of this communication.
- If the period for reply specified above is less than thirty (30) days, a reply within the statutory minimum of thirty (30) days will be considered timely.
- If NO period for reply is specified above, the maximum statutory period will apply and will expire SIX (6) MONTHS from the mailing date of this communication.
- Failure to reply within the set or extended period for reply will, by statute, cause the application to become ABANDONED (35 U.S.C. § 133). Any reply received by the Office later than three months after the mailing date of this communication, even if timely filed, may reduce any earned patent term adjustment. See 37 CFR 1.704(b).

Status

- 1) ☒ Responsive to communication(s) filed on 29 January 2004.
- 2a) ☒ This action is **FINAL**. 2b) ☐ This action is non-final.
- 3) ☐ Since this application is in condition for allowance except for formal matters, prosecution as to the merits is closed in accordance with the practice under *Ex parte Quayle*, 1935 C.D. 11, 453 O.G. 213.

Disposition of Claims

- 4) ☒ Claim(s) 1-6,9,10,12-20,22-25 and 27-38 is/are pending in the application.
- 4a) Of the above claim(s) _____ is/are withdrawn from consideration.
- 5) ☒ Claim(s) 1-3,5,6,12-15,32 and 38 is/are allowed.
- 6) ☒ Claim(s) 4,9,10,16-20,22-25,27-31 and 33-37 is/are rejected.
- 7) ☐ Claim(s) _____ is/are objected to.
- 8) ☐ Claim(s) _____ are subject to restriction and/or election requirement.

Application Papers

- 9) ☐ The specification is objected to by the Examiner.
- 10) ☒ The drawing(s) filed on 23 February 1999 is/are: a) ☒ accepted or b) ☐ objected to by the Examiner.
Applicant may not request that any objection to the drawing(s) be held in abeyance. See 37 CFR 1.85(a).
Replacement drawing sheet(s) including the correction is required if the drawing(s) is objected to. See 37 CFR 1.121(d).
- 11) ☐ The oath or declaration is objected to by the Examiner. Note the attached Office Action or form PTO-152.

Priority under 35 U.S.C. § 119

- 12) ☒ Acknowledgment is made of a claim for foreign priority under 35 U.S.C. § 119(a)-(d) or (f).
- a) ☒ All b) ☐ Some * c) ☐ None of:
- 1) ☒ Certified copies of the priority documents have been received.
 - 2) ☐ Certified copies of the priority documents have been received in Application No. _____.
 - 3) ☐ Copies of the certified copies of the priority documents have been received in this National Stage application from the International Bureau (PCT Rule 17.2(a)).

* See the attached detailed Office action for a list of the certified copies not received.

Attachment(s)

- | | |
|---|---|
| 1) <input type="checkbox"/> Notice of References Cited (PTO-892) | 4) <input type="checkbox"/> Interview Summary (PTO-413) |
| 2) <input type="checkbox"/> Notice of Draftsperson's Patent Drawing Review (PTO-948) | Paper No(s)/Mail Date: _____ |
| 3) <input type="checkbox"/> Information Disclosure Statement(s) (PTO-1449 or PTO/SB/08) | 5) <input type="checkbox"/> Notice of Informal Patent Application (PTO-152) |
| Paper No(s)/Mail Date: _____ | 6) <input type="checkbox"/> Other: _____ |

DETAILED ACTION

This Office action is in response to applicant's amendment filed on 29 January 2004.

Claim Rejections - 35 USC § 102

1. The following is a quotation of the appropriate paragraphs of 35 U.S.C. 102 that form the basis for the rejections under this section made in this Office action:

A person shall be entitled to a patent unless –

(e) the invention was described in (1) an application for patent, published under section 122(b), by another filed in the United States before the invention by the applicant for patent or (2) a patent granted on an application for patent by another filed in the United States before the invention by the applicant for patent, except that an international application filed under the treaty defined in section 351(a) shall have the effects for purposes of this subsection of an application filed in the United States only if the international application designated the United States and was published under Article 21(2) of such treaty in the English language.

2. Claims 4, 9-10, 16-20, 22-25, 27-31, 33-37 are rejected under 35 U.S.C. 102(e) as being anticipated by Schacham-Diamand et al.

Referring to Fig. 13 of Schacham-Diamand et al., an embodiment whereby copper is deposited in trench regions of a semiconductor structure (see column 8, lines 58-61) is disclosed with the following features:

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- Two trenches (25, 26) are formed in a dielectric layer (24) that in turn has been formed over a silicon substrate (see column 5, lines 13-32 and column 8, lines 32-39, 61-62);
- Copper interconnects (33) in contact with a catalytic seed layer (18a) are formed in the trenches (25, 26) such that the catalytic seed layer (18a) is sandwiched between the copper interconnects (33) and the dielectric layer (24);
- The catalytic seed layer (18a) can be comprised of platinum or rhodium (see column 7, lines 29-35 and column 11, lines 21-22, 48-49);
- The catalytic seed layer (18a) lines the trenches (25, 26) and, as a consequence, the catalytic seed layer (18a) is between the copper interconnects (33) and the underlying silicon substrate (not shown in Fig. 13, but is designated as 54 in Fig. 20);
- A diffusion barrier layer (17a) that can be comprised of titanium nitride, tantalum or tungsten (see column 6, lines 35-37, column 7, lines 26-28, and column 9, lines 16-17);
- The catalytic seed layer (18a) is in contact with the diffusion barrier layer (17a) (see column 9, lines 14-20 and column 6, lines 45-47); and
- The catalytic seed layer (18a) is sandwiched between the diffusion barrier layer (17a) and the copper interconnects (33).

These are all of the structural limitations set forth in claims 9-10, 16-20, 27, 30-31, 33-37 of the applicant's invention.

Regarding claim 4, Fig. 19 is an embodiment that is similar to the above embodiment of Schacham-Diamand et al. that additionally features the catalytic seed layer (18b) lining a via (i.e. a plug) (see column 9, line 52 to column 10, line 18). So, Schacham-Diamand et al. disclose all of the structural limitations of claim 4.

Regarding claims 22-25, 28-29, Schacham-Diamand et al. further disclose that additional levels of copper utilizing their catalytic seed layer, separated by dielectric layers (55), can be formed over the substrate (54) using plugs (51) to couple the metal lines (52) with the M1 level coupled directly to the substrate (see Fig. 20 and column 10, lines 26-33). So, Schacham-Diamand et al. also disclose all of the structural limitations of claims 22-25, 28-29.

Regarding the "prevention of voids due to electromigration" limitation in the above claims, this property is presumed to be inherent to the disclosure of Schacham-Diamand et al., per MPEP 2112.01, because their disclosed structures are essentially identical to the applicant's structure as claimed in claims 4, 9-10, 16-20, 22-25, 27-31, 33-37.

Regarding the various PVD, CVD, plating, etc. limitations in the above claims, it is noted that these are process limitations and the examination of product-by-process claims are based on the structure implied by the process limitations (see MPEP 2113). It is further noted that per MPEP 2113, the burden now shifts to the applicant to show an unobvious difference between the above rejection under 35 USC 102 (e) and applicant's claims 4, 9-10, 16-20, 22-25, 27-31, 33-37.

Allowable Subject Matter

3. Claims 1-3, 5-6, 12-15, 32, 38 are allowed.
4. The following is a statement of reasons for the indication of allowable subject matter:
 - Claims 1-3, 32 are allowed because the prior art of record does not teach or suggest a copper film interconnect, with a multi-layered copper structure, that is in contact with a neighboring layer of rhodium, ruthenium, iridium, osmium, or platinum, in combination with the other claim limitations;
 - Claims 5-6 are allowed because the prior art of record does not teach or suggest a copper film interconnect structure that includes a plug with ruthenium as the primary constituent element, in combination with the other claim limitations; and
 - Claims 38, 12-15 are allowed because the prior art of record does not teach or suggest a platinum film interconnect structure adjacent to a neighboring film that includes a material selected from a group consisting of rhodium, ruthenium, iridium, and osmium, in combination with the other claim limitations.

Response to Arguments

5. Applicant's arguments filed 29 January 2004 (see pages 25-28), regarding the above rejections to claims 4, 9-10, 16-20, 22-25, 27-31, 33-37 under 35 U.S.C. 102(e), have been fully considered but they are not persuasive.

The structure disclosed by Schacham-Diamand et al. includes copper interconnects (33) in contact with a catalytic seed layer (18a) that can be platinum or rhodium and, as shown above, this structure is substantially identical to the structure implied by the rejected product-by-process claims. The aluminum layer (19a) disclosed by Schacham-Diamand et al., as noted by the applicant, is dissolved during processing and, accordingly, does not appear to be present in their obtained structure. Per MPEP section 2112.01, "When the PTO shows a sound basis for believing that the products of the applicant and the prior art are the same, the burden shifts to the applicant to show that they are not." Further, the applicant is reminded that evidence of unexpected results cannot be used to overcome a rejection based on 35 USC 102 (see MPEP section 2131.04).

Conclusion

6. **THIS ACTION IS MADE FINAL.** Applicant is reminded of the extension of time policy as set forth in 37 CFR 1.136(a).

A shortened statutory period for reply to this final action is set to expire **THREE MONTHS** from the mailing date of this action. In the event a first reply is filed within **TWO MONTHS** of the mailing date of this final action and the advisory action is not mailed until after the end of the **THREE-MONTH** shortened statutory period, then the shortened statutory period will expire on the date the advisory action is mailed, and any extension fee pursuant to 37 CFR 1.136(a) will be calculated from the mailing date of the advisory action. In no event, however, will the statutory period for reply expire later than **SIX MONTHS** from the mailing date of this final action.

7. Any inquiry concerning this communication or earlier communications from the examiner should be directed to Stephen W. Smoot whose telephone number is 571-272-1698. The examiner can normally be reached on M-F (8:00am to 4:30pm).

If attempts to reach the examiner by telephone are unsuccessful, the examiner's supervisor, Carl Whitehead, Jr. can be reached on 571-272-1702. The fax phone number for the organization where this application or proceeding is assigned is 703-872-9306.

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Information regarding the status of an application may be obtained from the Patent Application Information Retrieval (PAIR) system. Status information for published applications may be obtained from either Private PAIR or Public PAIR. Status information for unpublished applications is available through Private PAIR only. For more information about the PAIR system, see <http://pair-direct.uspto.gov>. Should you have questions on access to the Private PAIR system, contact the Electronic Business Center (EBC) at 866-217-9197 (toll-free).

SWS


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